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(71) Applicants
Klein, Schanzlin & Becker Aktiengesellschaft, Postfach 225, Johann-Klein-Strasse 9, D—6710 Frankenthal (Pfalz), Germany, Fed. Rep. of Germany
(72) Inventor
Erich Holzhüter
(74) Agents
Forrester, Ketley & Co., Forrester House, 52 Bounds Green Road, London N11 2EY

(54) Centrifugal pump

(57) A centrifugal pump 1 with an impeller 2 and an inlet elbow 3 has a conduit 5 extending from the delivery side 7 to an annular chamber 4 encircling the intake flow chamber just upstream of the impeller. A plurality of apertures, distributed around the circumference of the intake flow chamber connect the latter with the chamber 4, the apertures being inclined circumferentially so that the fluid flow from chamber 4 via the apertures has a rotational sense about the centre-line of the intake flow chamber, which is the same as that in which the impeller 2 rotates. The injection of fluid into the intake flow chamber from the chamber 4 thus induces a swirl within the intake chamber which influences the occurrence and development of the part-load vortex in such a way that cavitation loading of the impeller under part-load conditions is reduced. A control valve 6, which may be operated automatically, is disposed in conduit 5 to enable the chamber 4 to be cut off from the delivery side of the pump under full load operating conditions.

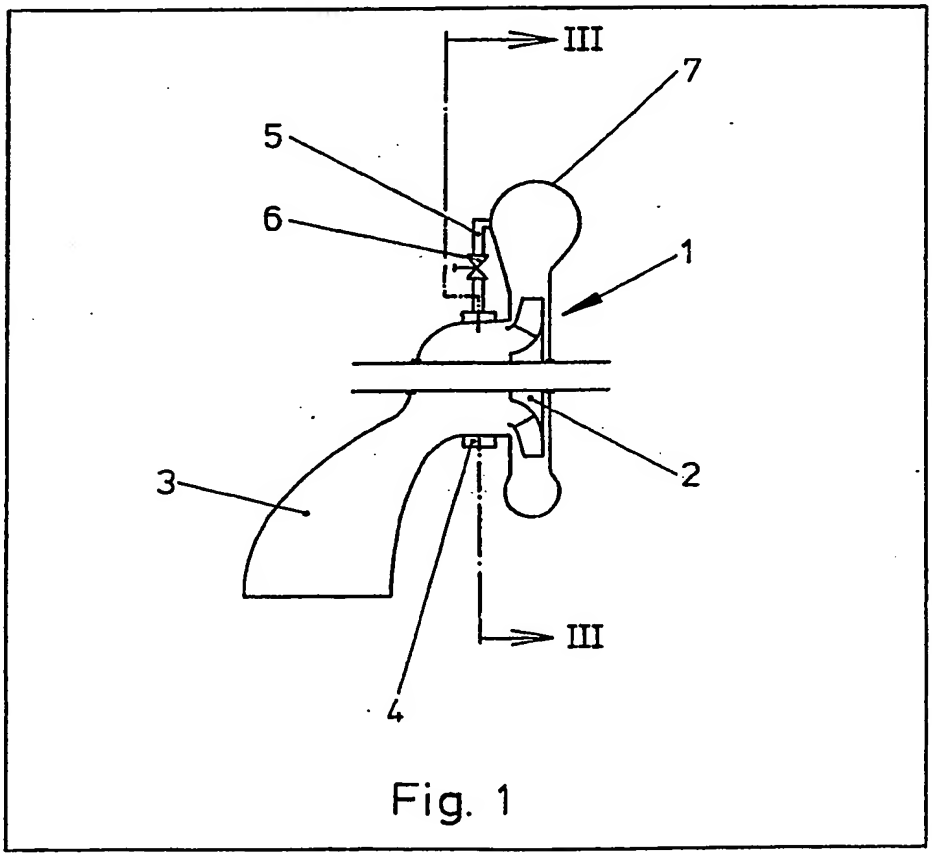

Fig. 1

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SPECIFICATION
Centrifugal pump

This invention relates to an arrangement for improving the cavitation characteristics of a centrifugal pump, in which a flow of the liquid under delivery is taken from the delivery side and fed to the centrifugal pump intake conduit.

A problem frequently arising in centrifugal pump installations is that such pumps are operated at full speed and with a highly throttled flow of medium for considerable periods. With such part-load operation, a centrifugal pump is subjected to increased cavitation stresses which are dependent on the nature of the intake piping, whether straight or curved. The part-load vortex emerging from the impeller under part-load operating conditions is affected differently by a straight intake pipe than by the technically preferred intake construction, incorporating an intake bend, also referred to as an inlet elbow. The occurrence and development of the part-load vortex is the decisive factor in the part-load cavitation characteristics of a centrifugal pump.

An object of the invention is to provide a centrifugal pump having an intake bend and having a simple arrangement, not interfering with operation in the optimum range, enabling cavitation loading of the impeller under part-load conditions to be decisively reduced.

According to the invention, there is provided a centrifugal pump having an intake bend and means whereby pumped fluid can be led from the delivery side of the pump to enter the flow chamber on the intake side of the pump via a plurality of peripherally distributed apertures, the arrangement being such that in operation, fluid passed via said apertures into the flow chamber on the intake side enters the latter tangentially with respect to the intake duct in such a way as to have a rotational component about the centre line of the intake duct, in the same rotational sense as that in which the impeller rotates.

As a result of the tangential introduction of fluid, via said apertures, on the intake side of the pump, by the formation of an identical swirl it is possible so to influence the occurrence and development of the part-load vortex that the inflow conditions are largely the same as with a straight intake pipe, so that a centrifugal pump having intake bends has part-load cavitation characteristics equal to those of a centrifugal pump with a straight intake pipe.

Preferably, the apertures are of a shape which increases the speed of flow. These apertures may, for example, each have the form of a flow nozzle. The velocity of the tangentially entering part-jets is made such as to influence the part-load vortex. The important factor is that the tangential injection into the intake bend takes place in the direction of rotation of the pump impeller.

In order to save energy, the flow rate of liquid under delivery is preferably injected automatically when part-load operation of the centrifugal pump starts, by means of a control valve disposed in a return conduit between the delivery and intake sides. A sensing device, for example, which is dependent on the delivery rate, may provide automatic control of the valve, thus precluding any deterioration of the efficiency in the optimum range and ensuring that injection takes place only in the part-load range which is subject to cavitation. The control valve may be an ordinary two-point controller, which is adjustable and, for example, opens at a part-load of $Q/Q_{opt.} = 0.7$.

To ensure uniform injection, it is preferable that the apertures should be preceded by an annular duct.

An embodiment of the invention is described below with reference to the drawings, in which:—

Figure 1 diagrammatically illustrates the invention applied to a centrifugal pump.

Figure 2 is a section on the line III—III in Figure 1 and

Figure 3 is a section on the line II—II in Figure 2.

Figure 1 shows, in section, a centrifugal pump 1 the impeller of which is preceded by an intake bend 3. An annular duct 4 disposed in the entry zone of the impeller 2 is connected, via a duct 5 containing a control valve 6, to the delivery side 7 of the centrifugal pump 1.

Figure 2 and 3 show how the apertures 8 upstream of the impeller intake orifice may be formed. Thus each aperture 8 has the form of a flow nozzle, such as to increase the speed of flow therethrough. During part-load operation, the annular duct 4 is fed with delivered liquid by means of the control valve 6, said liquid then flowing tangentially via apertures 8 into the intake bend upstream of the impeller.

The apertures 8 are so arranged that the flow from each into the intake bend is directed in the same rotational sense, relative to the axis of the annular chamber, as that in which the pump impeller rotates.

CLAIMS:

1. A centrifugal pump having an intake bend and means whereby pumped fluid can be led from the delivery side of the pump to enter the flow chamber on the intake side of the pump via a plurality of peripherally distributed apertures, the arrangement being such that in operation, fluid passed via said apertures into the flow chamber on the intake side enters the latter tangentially with respect to the intake duct in such a way as to have a rotational component about the centre line of the intake duct, in the same rotational sense as that in which the impeller rotates.

2. A centrifugal pump according to claim 1, in which said apertures have such a form as to increase the speed of flow of fluid passing therethrough into said flow chamber on the intake side of the pump.

3. A centrifugal pump according to claim 1 or claim 2 wherein said means whereby pumped fluid can be led from the delivery side of the pump to the flow chamber on the intake side includes a conduit with a control valve disposed therein,

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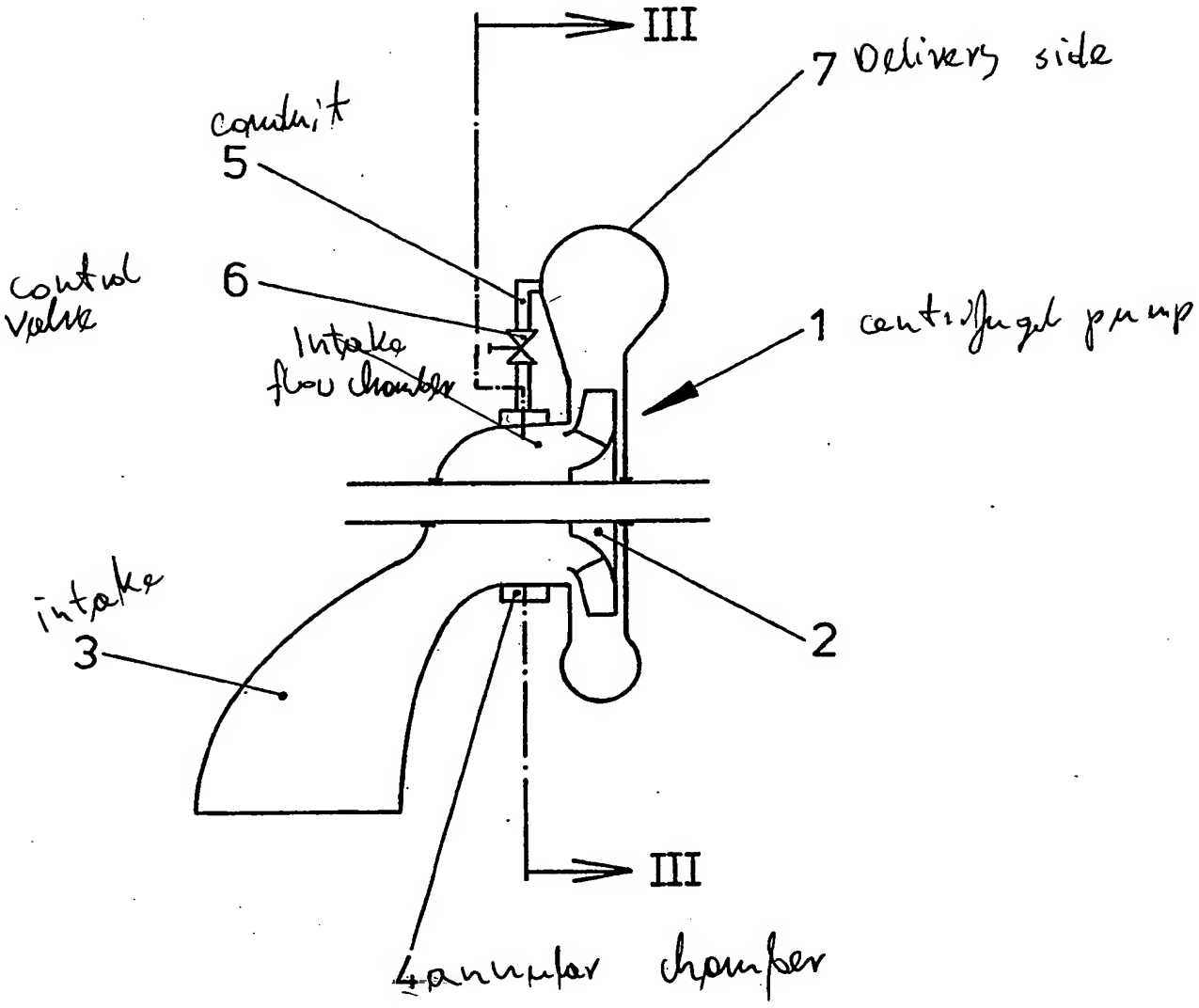

Fig. 1

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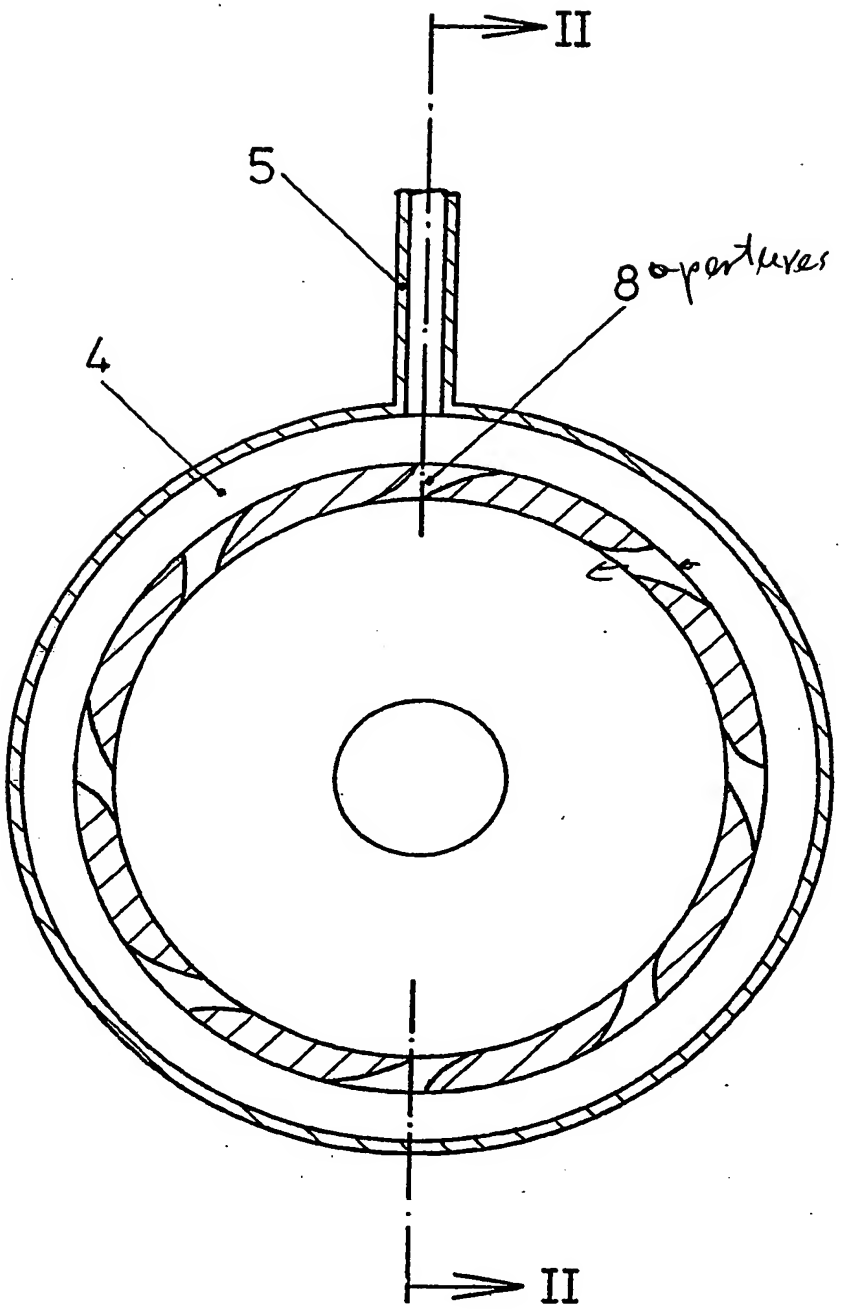

Fig. 2

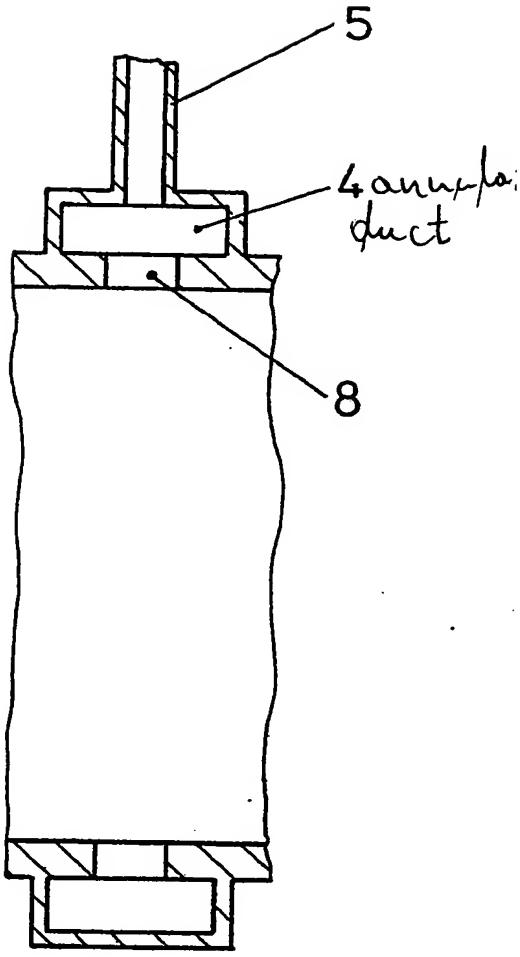

Fig. 3